Claims:

1. Use of an IPG antagonist in the preparation of a medicament for the treatment of conditions mediated by the release of IPGs from mast cells, basophils or eosinophils.

2. The use of claim 1 wherein the condition mediated by release of IPGs is atopic dermatitis, food hypersensitivity, allergies including seasonal, contact, drug, pollen, insect allergies, asthma (early and late phase), allergic interstitial pneumonitis, eczema, environmental lung disease, or another disorders mediated by infiltration of mast cells, basophils or eosinophils, or cells within their respective lineages.

3. The use of claim 1 or claim 2 wherein the IPG antagonist is an anti-IPG antibody.

4. The use of claim 1 or claim 2 wherein the IPG antagonist is a substance capable of inhibiting or preventing IPG release in mast cells, basophils or eosinophils in response to an allergen.

5. The use of claim 4 wherein the antagonist is an inhibitor of the enzyme GPI-PLD.

6. The use of claim 5 wherein the antagonist is an antibody capable of inhibiting IPG release by inhibiting cleavage of the IPGs caused by the enzyme GPI-PLD.

7. The use of claim 1 or claim 2 wherein the IPG antagonist is a competitive antagonists of the IPGs

released from mast cells, basophils or eosinophils.

8. The use of claim 7 wherein when the medicament is used to treat a human patient, the competitive IPG antagonist is an IPG derived from a non-human species.

9. The use of claim 8 wherein the antagonist is A-type IPG as obtainable from rat liver.

10. An inositolphosphoglycan (IPG) as obtainable from mast cells, basophils or eosinophils which is capable of causing histamine release from mast cells, basophils or eosinophils.

11. An inositolphosphoglycan (IPG) as obtainable from mast cells, basophils or eosinophils which is capable of causing histamine release from mast cells, basophils or eosinophils for use in a method of screening for antagonists of said IPG.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
SJK/BP5765615		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB 99/00981	29/03/1999	27/03/1998
Applicant		
UNIVERSITY COLLEGE LONDON et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 5 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

[ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readble form.

[ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [X] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

[ ] the text is approved as submitted by the applicant.

[X] the text has been established by this Authority to read as follows:

IPG ANTAGONISTS FOR THE TREATMENT OF CONDITIONS INVOLVING MAST CELLS, BASOPHILS AND EOSINOPHILS

5. With regard to the **abstract,**

[X] the text is approved as submitted by the applicant.

[ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

[ ] as suggested by the applicant.

[X] because the applicant failed to suggest a figure.

[ ] because this figure better characterizes the invention.

[ ] None of the figures.

INTERNATIONAL SEARCH REPORT

rnational application No.
PCT/GB 99/00981

Box I Obs rvations where certain claims w re found unsearchable (Continuation of it m 1 of first she t)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 1,2,4,7
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

B x II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 1,2,4,7

A composition or compound cannot be characterised by its mechanism of action sufficiently to allow a complete search to be made. As a consequence, the use of the term "IPG antagonist" in Claim 1 makes a complete search of the present claims impossible

Furthermore, the term "IPG antagonist" is considered to be unclear and unduly broad in scope.

Consequently, the search has been carried out for those parts of the claims which appear to be supported and clearly disclosed, namely those parts relating to Claims 3, 5, 6, 8 and 9.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/00981

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A61K31/70 A61K39/395

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	RADEMACHER T W ET AL: "Inositolphosphoglycan second messengers." BRAZILIAN JOURNAL OF MEDICAL AND BIOLOGICAL RESEARCH, (1994 FEB) 27 (2) 327-41. , XP002050248 cited in the application	1-9
Y	opening paragraph and the first paragraph on page 334	10,11

Y	WO 98 10791 A (HOEFT RADEMACHER LTD., UK;RADEMACHER, THOMAS WILLIAM; MCLEAN, PATRICIA) 1997 page 10, line 16 - page 16, line 1 page 17, line 19 - page 17, line 20	10,11

	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 September 1999	24.09.99

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Pilling, S

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 98 11435 A (HOEFT RADEMACHER LIMITED, UK;RADEMACHER, THOMAS WILLIAM; MCLEAN, PATRI) 1997 page 13, line 15 - page 18, line 35 page 20, line 17 - page 20, line 18 ---	10,11
Y	WO 98 11117 A (HOEFT RADEMACHER LTD., UK;RADEMACHER, THOMAS WILLIAM; CARO, HUGO) 1997 cited in the application page 11, line 3 - page 15, line 7 page 34, line 28 - page 36, line 13 page 25, line 10 - page 25, line 31 ---	10,11
Y	WO 98 11116 A (HOEFT RADEMACHER LTD., UK;RADEMACHER, THOMAS WILLIAM; CARO, HUGO) 1997 cited in the application page 10, line 17 - page 14, line 21 page 17, line 14 - page 18, line 9 page 30, line 1 - page 31, line 23 ---	10,11
Y	WO 96 29425 A (UNIV LONDON ;RADEMACHER THOMAS WILLIAM (GB); CARO HUGO NORBERTO (G) 26 September 1996 (1996-09-26) example 2A -----	10,11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 99/00981

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9810791 A	19-03-1998	AU 4310297 A	02-04-1998
		EP 0939651 A	08-09-1999
WO 9811435 A	19-03-1998	AU 4130497 A	02-04-1998
		EP 0925503 A	30-06-1999
WO 9811117 A	19-03-1998	AU 4310197 A	02-04-1998
		EP 0925304 A	30-06-1999
WO 9811116 A	19-03-1998	AU 4130797 A	02-04-1998
		EP 0925305 A	30-06-1999
WO 9629425 A	26-09-1996	AU 5116496 A	08-10-1996
		EP 0815255 A	07-01-1998
		JP 11503307 T	26-03-1999

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
SJK/BP5765615		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB99/00981	29/03/1999	27/03/1998
International Patent Classification (IPC) or national classification and IPC A61K31/70		
Applicant UNIVERSITY COLLEGE LONDON et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which hav been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
15/10/1999	26.06.2000
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Pilling, S Telephone No. +49 89 2399 8461

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/00981

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-32 as originally filed

Claims, No.:

1-11 as received on 12/04/2000 with letter of 12/04/2000

Drawings, sheets:

1/4-4/4 as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 1-11
	No:	Claims
Inventive step (IS)	Yes:	Claims 1-11
	No:	Claims
Industrial applicability (IA)	Yes:	Claims 1-11
	No:	Claims

2. Citations and explanations

see separate sheet

SECTION V

1. The present application relates to the use of particular antagonists (a-c) in the preparation of medicaments for the treatment of conditions mediated by the release of IPGs from mast cells, basophils or eosinophils (Claims 1 to 9) and; IPGs obtainable from mast cells basophils or eosinophils (Claims 10 and 11).

2. The documents cited in the International Search Report (ISR) are consecutively numbered D1 to D6 in the order of their listing. If not indicated otherwise, reference is made to the passages cited in said ISR.

Claims 1 to 9

3. None of the documents cited in the ISR discloses that conditions mediated by the release of IPGs from mast cells may be treated using antagonists (a) to (c) as defined in present Claim 1.

4. Thus, the subject matter of Claims 1 to 9 is new (Article 33(2) PCT).

5. The following comments are relevant to inventive step of Claims 1 to 9; Document D1 (Brazilian J. Med. Biol. Res, 1994, 27 (2), pp 327-341) discloses that IPGs "*appear to mediate the action of ..//..IgE dependant activation of rat mast cells*" (see the opening paragraph in D1) and that "*antibodies against serum GPI-PLD have been shown to block IgE-stimulated histamine release in rat mast cells (15) which is IPG dependant*" (see the first paragraph on page 334 of D1). Document D1 supports these statements by referring to an abstract (see reference 15) which reports that antibodies against serum GPI-PLD can be used to block IgE stimulated histamine release *in vitro* in rat mast cells which have been sensitized with anti-TNP and triggered with TNP-OVA. Thus, document D1 appears to provide some results linking IPG's, GPI-PLD and allergy. In view, however, of the following deficiencies in document D1, it does not seem to be obvious to to use the GPI-PLD inhibitor of this document, *i.e.* anti-GPI-PLD antibody, to treat conditions mediated by the release of IPG's from mast cells; a) the teaching of document D1 seems wholly directed towards elucidating cellular receptor mechanisms and there seems to be no suggestion or pointer in

document D1 towards development of therapeutic treatments of any type and ; b) the mechanism of IPG release described in document D1 is not completely clear, in particular it was not known whether serum or mast cell GPI-PLD was involved in IPG release (see page 334 of D1).

6. Hence, the teaching of document D1 is insufficiently definitive and seems to fall short of showing that the skilled person would have had a reasonable expectation of success when using anatagonists (a) to (c) as defined in present Claim 1 for the treatment of conditions mediated by the release of IPGs from mast cells, basophils or eosinophils. Consequently, the subject matter of Claims 1 to 9 appears to be inventive (Article 33(2) PCT).

Claims 10 and 11

7. None of the documents cited in the present ISR discloses the purification of an IPG obtainable from mast cells, basophils or eosinophils. Although each of documents D2, D3, D4, D5 and D6 (WO-96/29425) show that isolation of IPGs from a variety of tissues (other than mast cells, basophils and eosinophils) is conventional, it appears, on the basis of statements by the Applicant, that IPG's obtainable from mast cells, basophils or eosinophils would be recognizably different from IPG's isolated from other tissues.

8. Thus, the subject matter of Claims 10 and 11 is new (Article 33(2) PCT).

9. The following comments are relevant to inventive step of Claims 10 and 11; as indicated above document D1 shows that the presence of IPG in association with mast cells at least is known. There is no indication in this document however that said IPG could be purified or that said purified IPG would be useful, for example, in screening for therapeutic antagonists of said IPG. Hence, there does not seem to be any clear motivation in the prio art for the skilled man to prepare purified IPG from mast cells and the subject matter of Claims 10 and 11 appears to be inventive (Article 33(3) PCT).

Claims:

1. Use of an antagonist in the preparation of a medicament for the treatment of conditions mediated by the release of IPGs from mast cells, basophils or eosinophils, wherein the antagonist is:

(a) a substance which is capable of inhibiting release of the IPGs by inhibiting the enzyme GPI-PLD;

(b) a substance which is capable of specifically binding to the IPGs and inhibiting the release of histamine caused by the IPGs; or

(c) a substance which is capable of competing with IPGs released from mast cells, basophils or eosinophils but which does not cause allergic stimulation of these cell types.

2. The use of claim 1, wherein the condition mediated by release of IPGs is atopic dermatitis, food hypersensitivity, allergies including seasonal, contact, drug, pollen, insect allergies, asthma (early and late phase), allergic interstitial pneumonitis, eczema, environmental lung disease, or another disorders mediated by infiltration of mast cells, basophils or eosinophils, or cells within their respective lineages.

3. The use of claim 1 or claim 2, wherein the IPG antagonist is an anti-IPG antibody.

4. The use of claim 1 or claim 2, wherein the IPG antagonist is a substance capable of inhibiting or preventing IPG release in mast cells, basophils or eosinophils in response to an allergen.

5. The use of claim 4, wherein the antagonist is an

inhibitor of the enzyme GPI-PLD.

6. The use of claim 5, wherein the antagonist is an antibody capable of inhibiting IPG release by inhibiting cleavage of the IPGs caused by the enzyme GPI-PLD.

7. The use of claim 1 or claim 2, wherein the IPG antagonist is a competitive antagonists of the IPGs released from mast cells, basophils or eosinophils.

8. The use of claim 7, wherein when the medicament is used to treat a human patient, the competitive IPG antagonist is an IPG derived from a non-human species.

9. The use of claim 8, wherein the antagonist is A-type IPG as obtainable from rat liver.

10. An inositolphosphoglycan (IPG) as obtainable from mast cells, basophils or eosinophils which is capable of causing histamine release from mast cells, basophils or eosinophils.

11. An inositolphosphoglycan (IPG) as obtainable from mast cells, basophils or eosinophils which is capable of causing histamine release from mast cells, basophils or eosinophils for use in a method of screening for antagonists of said IPG.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A61K 31/00 — A2

(11) International Publication Number: WO 99/49855

(43) International Publication Date: 7 October 1999 (07.10.99)

(21) International Application Number: PCT/GB99/00981

(22) International Filing Date: 29 March 1999 (29.03.99)

(30) Priority Data:
9806645.9 27 March 1998 (27.03.98) GB

(71) Applicant *(for all designated States except US)*: UNIVERSITY COLLEGE LONDON [GB/GB]; Gower Street, London WC1E 6BT (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: RADEMACHER, Thomas, William [US/GB]; Foxcomb, The Ridgeway, Boars Hill, Oxford OX1 5EY (GB). WHITBY, Helen [AU/GB]; 46 Harley Street, London W1N 1AD (GB).

(74) Agents: KIDDLE, Simon, J. et al.; Mewburn Ellis, York House, 23 Kingsway, London WC2B 6HP (GB).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: MATERIALS AND METHODS RELATING TO THE TREATMENT OF CONDITIONS INVOLVING MAST CELLS, BASOPHILS AND EOSINOPHILS

(57) Abstract

This application discloses that inositolphosphoglycans (IPGs) can be obtained from basophils, eosinophils and mast cells and that allergen stimulation of these cells results in IPG release. It also shows that IPGs are second messengers for allergic stimulation as the addition of some types of purified IPGs to non–allergen stimulated cells resulted in histamine release or degranulation. Thus, IPG antagonists can be used for the treatment of conditions (especially allergy and asthma) mediated by the release of IPGs from mast cells, basophils or eosinophils. Preferred IPG antagonists include anti–IPG antibodies, inhibitors of the enzyme GPI–PLD and competitive antagonists.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing internatiónal applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
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DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

Materials and Methods Relating to the Treatment of Conditions Involving Mast Cells, Basophils and Eosinophils

Field of the Invention

The present invention relates to materials and methods relating to the treatment of conditions involving mast cells, basophils and eosinophils, and in particular to inositolphoglycans (IPGs) as obtainable from mast cells, basophils or eosinophils, and to uses of inositolphosphoglycan (IPG) antagonists in the treatment of conditions that are mediated by the release of IPGs from mast cells, basophils or eosinophils, such as allergies or asthma.

Background of the Invention

Allergy affects twenty percent of the worlds' population and the alarming increase in its prevalence, morbidity and mortality over the past decade has led to its designation as the number one environmental disease (Sutton and Gould, 1993). Scientists have become increasingly interested in the mechanisms of allergy and the potential benefits of discovering therapeutics to block these mechanisms.

The traditional model of type one hypersensitivity (acute allergic reaction), involves the cross-linking of IgE receptors on basophils and mast cells by the antigen. The cross-linking leads to receptor clustering, degranulation of vesicles and the release of pre-formed mediators, such as histamine. In addition, newly formed mediators such as prostaglandins and leukotrienes are

generated (Sampson et al, 1989). This reaction is fast and relatively easy to resolve with anti-histamines and steroids.

In certain individuals, a more malignant form of allergy is seen after the acute allergic reaction subsides, which is characterised by a recrudescence of symptoms after a period of 3 to 11 hours. This type of reaction, the Late Phase Reaction (LPR), occurs in chronic allergic diseases such as chronic asthma and eczema (Kuna et al, 1993). LPR in the skin is characterised by oedema and erythema (Solley et al, 1976), and in the nose by increased resistance of airflow (MacLean et al, 1971). The pathogenesis of the LPR is complex, poorly understood and difficult to resolve with currently available standard therapies.

Research into the pathogenesis of LPR, revealed an eight fold increase in basophil numbers and a marked absence of the classic mast cell marker, prostaglandin 2. It was postulated, therefore, that the cell of significance in the LPR was the basophil (Lichtenstein, 1988). During experiments to ascertain the influence of the immune system on the function of basophils, it was determined that cultured macrophages produced a factor which effected histamine release from human basophils (Liu et al, 1986) in the absence of antigen persistence (Lichtenstein, 1988). The experiment was repeated using a factor found in fluids derived from the LPR skin blisters (MacDonald et al, 1995) and with nasal washings from both atopic and non-atopic individuals (Sim et al,

1992), and the factor was designated histamine releasing factor (HRF).

Subsequent experimental studies found that study groups, consisting of approximately 50% of atopic individuals, reacted to HRF, although it should be noted that the percentage varies depending on the nature of the atopic disease (50% in atopic rhinitis compared with 70% in atopic asthma) (Fischer et al, 1987).

Many of the actions of growth factors on cells are thought to be mediated by a family of inositol phosphoglycan (IPG) second messengers (Rademacher et al, 1994). It is thought that the source of IPGs is a "free" form of glycosyl phosphatidylinositol (GPI) situated in cell membranes. IPGs are thought to be released by the action of phosphatidylinositol-specific phospholipases following ligation of growth factors to receptors on the cell surface. There is evidence that IPGs mediate the action of a large number of growth factors including insulin, nerve growth factor, hepatocyte growth factor, insulin-like growth factor I (IGF-I), fibroblast growth factor, transforming growth factor β, the action of IL-2 on B-cells and T-cells, ACTH signalling of adrenocortical cells, FSH and hCG stimulation of granulosa cells, thyrotropin stimulation of thyroid cells, cell proliferation in the early developing ear and rat mammary gland.

Soluble IPG fractions have been obtained from a variety of animal tissues including rat tissues (liver, kidney,

muscle brain, adipose, heart) and bovine liver. IPG biological activity has also been detected in malaria parasitized RBC and mycobacteria. We have divided the family of IPG second messengers into distinct A and P-type subfamilies on the basis of their biological activities. In the rat, release of the A- and P-type mediators has been shown to be tissue-specific (Kunjara et al, 1995).

However, until very recently, it was not possible to isolate single purified components from the tissue derived IPG fractions, much less in sufficient quantities to allow structural characterisation. Accordingly, prior art studies were based on the biological activities of the IPG containing fractions, and speculation as to the identity of the active components from non-human sources of the fractions were based on indirect evidence from metabolic labelling and cleavage techniques.

Summary of the Invention

Broadly, the present invention is based on the finding that IPGs can be obtained from basophils, eosinophils and mast cells and that allergen stimulation of these cells results in IPG release. The experiments also show that IPGs are second messengers for allergic stimulation as the addition of some types of purified IPGs to non-allergen stimulated cells resulted in histamine release or degranulation.

Accordingly, in a first aspect, the present invention provides an inositolphosphoglycan (IPG) as obtainable

from mast cells, basophils or eosinophils which is capable of causing histamine release from mast cells, basophils or eosinophils.

In a further aspect, the present invention provides the use of an inositolphosphoglycan (IPG) as obtainable from mast cells, basophils or eosinophils which is capable of causing histamine release from mast cells, basophils or eosinophils in a method of screening for antagonists of said IPG.

In a further aspect, the present invention provides the use of an IPG antagonist in the preparation of a medicament for the treatment of conditions mediated by the release of IPGs from mast cells, basophils or eosinophils.

In a further aspect, the present invention provides a method of preventing the release of IPGs from mast cells, basophils or eosinophils, the method comprising exposing the mast cells, basophils or eosinophils to an IPG antagonist.

In a further aspect, the present invention provides a method of treating a condition mediated by release of IPGs from mast cells, basophils or eosinophils, the method comprising administering an effective amount of an IPG antagonist to a patient.

Preferably, the IPG antagonist acts specifically on mast cells, basophils and/or eosinophils. However, the

activity of the antagonist can be provided in a number of ways. In one embodiment, the IPG antagonist can be an antibody capable of specifically binding to IPGs, in particular IPGs produced by mast cells, basophils or eosinophils. The use of neutralising antibodies is preferred, e.g. antibodies capable of neutralising one or more of the activities of IPGs on mast cells, basophils or eosinophils, e.g stimulating histamine release.

Alternatively, the IPG antagonists can act to inhibit or prevent IPG release in mast cells, basophils or eosinophils, e.g. in response to an allergen. An example of this type of antagonist is a specific inhibitor of the enzyme GPI-PLD, which is involved in the release of the IPG from the mast cell, basophil or eosinophil surface following allergen stimulation. A further example is an anti-GPI-PLD antibody which acts to inhibit IPG release by inhibiting cleavage of the IPGs caused by the enzyme GPI-PLD.

As the action of IPGs is generally tissue specific, IPGs derived from other tissues can provide a source of competitive antagonists to IPGs released from mast cells, basophils or eosinophils, i.e. substances which compete with the mast cell, basophil or eosinophil derived IPGs, but which do not share their activity in relation to mast cells, basophils or eosinophils, e.g. do not cause histamine release. An example of this type of antagonist is the rat liver A-type IPG described in the examples below, which in combination with an adjunct (in this case Ca^{2+}) was antagonised the hexosaminidase release from

basophil cell line RBL 2H3. Other IPGs could be screened for mast cell, basophil or eosinophil antagonist activity using the assays described below.

Other suitable IPG antagonists can be prepared and screened by those skilled in the art based on the detailed teaching below.

The present invention is applicable to the treatment of a range of disorders mediated by IPG release from mast cells, basophils or eosinophils. These include conditions mediated by the following mediators and cytokines, the IPGs acting a second messengers for these mediators or cytokines:

(a) Preformed mediators, including histamine, HRF, and neutral proteases.

(b) Newly generated mediators (lipid derived), including prostaglandins (PGD_2, $PGF_2\alpha$) thromboxanes and leukotrienes.

(c) Cytokines, including IL-3, IL-4, IL-5, IL-6, IL-8 GM-CSF, TNFα, IFNα, MIP 1α/1β, T-cell activation antigen.

(d) Other mediators, including PAF and RANTES.

The conditions that can be prevented or treated using the IPG antagonists include atopic dermatitis, food hypersensitivity, allergies including seasonal, contact, drug, pollen, insect allergies, asthma (both early and late phase), allergic interstitial pneumonitis, eczema, environmental lung disease, and other disorders mediated by infiltration of mast cells, basophils or eosinophils,

or cells within their respective lineages.

Embodiments of the present invention will now be described by way of example and not by limitation with reference to the accompanying drawings.

Brief Description of the Drawings

Figure 1 shows that IPGs obtained from a basophil cell line RBL 2H3 cause the release of histamine from the RBL 2H3 cells. Figure 1 shows % histamine release from the cells plotted against amount of IPG added.

Figure 2 shows that the response of the basophils is tissue-specific since IPGs isolated from human placental were not able to cause histamine release (the hexosaminidase release (y axis) is a surrogate marker for histamine release).

Figure 3 shows that rat liver P-type IPG has no effect on the RBL 2H3 cells. In contrast, the rat A-type liver IPG was able to block some of the spontaneous release. The effect is specific since no inhibition was seen in the absence of calcium (Figure 3 bottom).

Figure 4 shows results from experiments to determine the role of GPI-PLD in Type One hypersensitivity reactions.

Detailed Description

IPGs and IPG Analogues

Studies have shown that A-type mediators modulate the activity of a number of insulin-dependent enzymes such as

cAMP dependent protein kinase (inhibits), adenylate cyclase (inhibits) and cAMP phospho-diesterases (stimulates). In contrast, P-type mediators modulate the activity of insulin-dependent enzymes such as pyruvate dehydrogenase phosphatase (stimulates), glycogen synthase phosphatase (stimulates) and cAMP dependent protein kinase (inhibits). The A-type mediators mimic the lipogenic activity of insulin on adipocytes, whereas the P-type mediators mimic the glycogenic activity of insulin on muscle. Both A and P-type mediators are mitogenic when added to fibroblasts in serum free media. The ability of the mediators to stimulate fibroblast proliferation is enhanced if the cells are transfected with the EGF-receptor. A-type mediators can stimulate cell proliferation in the chick cochleovestibular ganglia (CVG).

Soluble IPG fractions having A-type and P-type activity have been obtained from a variety of animal tissues including rat tissues (liver, kidney, muscle brain, adipose, heart) and bovine liver. A and P-type IPG biological activity has also been detected in human liver and placenta, malaria parasitized RBC and mycobacteria. The ability of a polyclonal anti-inositolglycan antibody to inhibit insulin action on human placental cytotrophoblasts and BC3H1 myocytes or bovine-derived IPG action on rat diaphragm and CVG suggests cross-species conservation of many structural features. However, it is important to note that although the prior art includes these reports of A and P-type IPG activity in some biological fractions, the purification or

characterisation of the agents responsible for the activity is not disclosed.

A-type substances are cyclitol-containing carbohydrates, also containing Zn^{2+} ion and optionally phosphate and having the properties of regulating lipogenic activity and inhibiting cAMP dependent protein kinase. They may also inhibit adenylate cyclase, be mitogenic when added to EGF-transfected fibroblasts in serum free medium, and stimulate lipogenesis in adipocytes.

P-type substances are cyclitol-containing carbohydrates, also containing Mn^{2+} and/or Zn^{2+} ions and optionally phosphate and having the properties of regulating glycogen metabolism and activating pyruvate dehydrogenase phosphatase. They may also stimulate the activity of glycogen synthase phosphatase, be mitogenic when added to fibroblasts in serum free medium, and stimulate pyruvate dehydrogenase phosphatase.

Methods for obtaining A-type and P-type IPGs are set out in detail in Caro et al, 1997, and in WO98/11116 and WO98/11117.

Antagonists

As mentioned above, in the present invention, IPG antagonists include substances which have one or more of the following properties:

(a) Substances capable of inhibiting release of the IPGs from mast cells or basophils, e.g. in response to an

allergen;

(b) Substances capable of reducing the level of IPGs released from mast cells, basophils or eosinophils by specifically binding to such IPGs; and/or,

(c) Substances capable of reducing the effects of IPGs released from mast cells, basophils or eosinophils, e.g. substances which compete with the mast cell/basophil/eosinophil derived IPGs, but which do not cause allergic stimulation of these cell types.

In one embodiment, the IPG antagonists can act to prevent IPG release in mast cells, basophils or eosinophils, e.g. in response to an allergen. An example of such an antagonist is an inhibitor of the enzyme GPI-PLD which is involved in the release of the IPG from the mast cell, basophil or eosinophil surface following allergen stimulation. Another inhibitor is an anti-GPI-PLD antibody which acts to prevent IPG release by inhibiting cleavage of the IPGs caused by the enzyme GPI-PLD.

Alternatively, the IPG antagonist can be an antibody capable of specifically binding to IPGs, e.g. to reduce IPG levels in a patient. Preferably, the antibodies are capable of specifically binding to IPGs produced by mast cells, basophils or eosinophils. The use of neutralising antibodies is preferred, e.g. antibodies which are capable of neutralising the activity of IPGs causing histamine release from mast cells, basophils or eosinophils. Examples of monoclonal antibodies capable

of specifically binding IPGs are the antibodies produced by hybridoma cell lines 2F7, 2D1 and 5H6 deposited at European Collection of Cell Cultures (ECACC) under accession numbers 98051201, 98031212 and 98030901. Protocols for making monoclonal and polyclonal anti-IPG antibodies are set out below.

As the action of IPGs is generally tissue specific, IPGs derived from other tissues can provide a source of competitive antagonists to IPGs released from mast cells, basophils or eosinophils. An example of this type of antagonist is the rat liver A-type IPG described in the examples below, which in combination with an adjunct (in this case Ca^{2+}) was antagonised the hexosaminidase release from basophil cell line RBL 2H3. Synthetic chemical compounds can also act as IPG antagonists. P and A-type IPGs suitable for screening for use as competitive antagonists are described above. Synthetic IPG analogues include compound C3, 1D-6-O-(2-amino-2-deoxy-α-D-glucopyranosyl)-myo-inositol 1,2-(cyclic phosphate), as prepared in Zapata et al, 1994, and compound C4, 1D-6-O-(2-amino-2-deoxy-α-D-glucopyranosyl)-chiro-inositol 1-phosphate, as prepared in Jaramillo et al, 1994.

In one embodiment, antibodies are useful IPG antagonists that can be used in the present invention. Protocols for obtaining anti-IPG antibodies are set out below. However, the deposited antibodies or other antibodies made using the protocols below can be subjected to the techniques of recombinant DNA technology to produce other antibodies or chimeric molecules which retain the

specificity of the original antibody. Such techniques may involve introducing DNA encoding the immunoglobulin variable region, or the complementarity determining regions (CDRs), of an antibody to the constant regions, or constant regions plus framework regions, of a different immunoglobulin. See, for instance, EP 0184187 A, GB-A-2188638 or EP 0239400 A. A hybridoma producing a monoclonal antibody may be subject to genetic mutation or other changes, which may or may not alter the binding specificity of antibodies produced.

Antibodies may be obtained using techniques which are standard in the art. Methods of producing antibodies include immunising a mammal (e.g. mouse, rat, rabbit, horse, goat, sheep or monkey) with the protein or a fragment thereof. Antibodies may be obtained from immunised animals using any of a variety of techniques known in the art, and screened, preferably using binding of antibody to antigen of interest. For instance, Western blotting techniques or immunoprecipitation may be used (Armitage et al, Nature, 357:80-82, 1992). Isolation of antibodies and/or antibody-producing cells from an animal may be accompanied by a step of sacrificing the animal.

As an alternative or supplement to immunising a mammal with a peptide, an antibody specific for a protein may be obtained from a recombinantly produced library of expressed immunoglobulin variable domains, e.g. using lambda bacteriophage or filamentous bacteriophage which display functional immunoglobulin binding domains on

their surfaces; for instance see WO92/01047. The library may be naive, that is constructed from sequences obtained from an organism which has not been immunised with any of the proteins (or fragments), or may be one constructed using sequences obtained from an organism which has been exposed to the antigen of interest.

Antibodies according to the present invention may be modified in a number of ways. Indeed the term "antibody" should be construed as covering any binding substance having a binding domain with the required specificity. Thus the invention covers antibody fragments, derivatives, functional equivalents and homologues of antibodies, including synthetic molecules and molecules whose shape mimics that of an antibody enabling it to bind an antigen or epitope.

Example antibody fragments, capable of binding an antigen or other binding partner are the Fab fragment consisting of the VL, VH, Cl and CH1 domains; the Fd fragment consisting of the VH and CH1 domains; the Fv fragment consisting of the VL and VH domains of a single arm of an antibody; the dAb fragment which consists of a VH domain; isolated CDR regions and $F(ab')_2$ fragments, a bivalent fragment including two Fab fragments linked by a disulphide bridge at the hinge region. Single chain Fv fragments are also included.

Humanised antibodies in which CDRs from a non-human source are grafted onto human framework regions, typically with the alteration of some of the framework

amino acid residues, to provide antibodies which are less immunogenic than the parent non-human antibodies, are also included within the present invention

A hybridoma producing a monoclonal antibody according to the present invention may be subject to genetic mutation or other changes. It will further be understood by those skilled in the art that a monoclonal antibody can be subjected to the techniques of recombinant DNA technology to produce other antibodies or chimeric molecules which retain the specificity of the original antibody. Such techniques may involve introducing DNA encoding the immunoglobulin variable region, or the complementarity determining regions (CDRs), of an antibody to the constant regions, or constant regions plus framework regions, of a different immunoglobulin. See, for instance, EP 0184187 A, GB-A-2188638 or EP 0239400 A. Cloning and expression of chimeric antibodies are described in EP 0120694 A and EP 0125023 A.

Hybridomas capable of producing antibody with desired binding characteristics are within the scope of the present invention, as are host cells, eukaryotic or prokaryotic, containing nucleic acid encoding antibodies (including antibody fragments) and capable of their expression. The invention also provides methods of production of the antibodies including growing a cell capable of producing the antibody under conditions in which the antibody is produced, and preferably secreted.

Pharmaceutical Compositions

The IPGs and IPG antagonists of the invention can be formulated in pharmaceutical compositions. These compositions may comprise, in addition to one or more of the mediators or antagonists, a pharmaceutically acceptable excipient, carrier, buffer, stabiliser or other materials well known to those skilled in the art. Such materials should be non-toxic and should not interfere with the efficacy of the active ingredient. The precise nature of the carrier or other material may depend on the route of administration, e.g. oral, intravenous, cutaneous or subcutaneous, nasal, intramuscular, intraperitoneal routes.

Pharmaceutical compositions for oral administration may be in tablet, capsule, powder or liquid form. A tablet may include a solid carrier such as gelatin or an adjuvant. Liquid pharmaceutical compositions generally include a liquid carrier such as water, petroleum, animal or vegetable oils, mineral oil or synthetic oil. Physiological saline solution, dextrose or other saccharide solution or glycols such as ethylene glycol, propylene glycol or polyethylene glycol may be included.

For intravenous, cutaneous or subcutaneous injection, or injection at the site of affliction, the active ingredient will be in the form of a parenterally acceptable aqueous solution which is pyrogen-free and has suitable pH, isotonicity and stability. Those of relevant skill in the art are well able to prepare suitable solutions using, for example, isotonic vehicles

such as sodium chloride injection, Ringer's injection, lactated Ringer's injection. Preservatives, stabilisers, buffers, antioxidants and/or other additives may be included, as required.

Whether it is a polypeptide, antibody, peptide, small molecule or other pharmaceutically useful compound according to the present invention that is to be given to an individual, administration is preferably in a "prophylactically effective amount" or a "therapeutically effective amount" (as the case may be, although prophylaxis may be considered therapy), this being sufficient to show benefit to the individual. The actual amount administered, and rate and time-course of administration, will depend on the nature and severity of what is being treated. Prescription of treatment, e.g. decisions on dosage etc, is within the responsibility of general practitioners and other medical doctors, and typically takes account of the disorder to be treated, the condition of the individual patient, the site of delivery, the method of administration and other factors known to practitioners. Examples of the techniques and protocols mentioned above can be found in Remington's Pharmaceutical Sciences, 16th edition, Oslo, A. (ed), 1980.

A composition may be administered alone or in combination with other treatments, either simultaneously or sequentially dependent upon the condition to be treated. Many of the conditions that can be treated using the invention are base on reaction to allergens. Thus, the

treatments proposed herein could be combined with known treatments for these conditions.

Materials and Methods

Production of Polyclonal and Monoclonal Antibodies Against Inositolphosphoglycans (IPGs)

Inositolphosphoglycan (soluble form) obtained by PI-PLC treatment of GPI purified from rat liver by sequential Thin Layer Chromatography (TLC) was used to immunize New Zealand rabbits and Balb/c mice as described below. Alternatively, human IPGs or those from other species can be obtained using the methods described in Caro et al, 1997.

Rabbit Immunisation Procedure

Two New Zealand rabbits were anaesthetized and then immunised with 750µg of IPG (soluble form) mixed in 1ml of PBS with 1ml of complete Freund's adjuvant (CFA). The antigen-adjuvant emulsion was administered 1.5ml by intradermal (id) injection and 0.5ml by intramuscular (im) injection. After one month, this protocol was repeated except that incomplete Freund's adjuvant (IFA) was used, and 1.5ml by administered by subcutaneous (sc) injection and 0.5ml by intramuscular (im) injection. This was repeated again on days 60, 90, 120 and 150.

Mouse Immunisation Procedure

Four female Balb/c 6 weeks old mice were immunised with 60µg of IPG (soluble form) in 250µl of PBS with 250µl of CFA. The antigen-adjuvant emulsion was injected by intraperitoneal (ip) injection. After 21 days, the

injection was repeated except that IFA was used. On days 42 and 63 all the animals were injected ip with IFA. On day 84, the best responder was injected 100µl PBS containing 60µg of IPG intravenous (iv) and 100µl PBS containing 60µg of IPG (ip). After 87 days, splenocytes from best responder were fused to myeloma cells using conventional techniques. Monitor test bleeds were realized regularly.

Assay Procedures

Histamine Assay

The extraction of HNMT was performed as discussed in Verburg et al, 1983, using fresh male Wistar rat kidney tissue. The tissue was homogenised with 0.25M sucrose solution (1:3 v/w) and centrifuged at 40,000G for 15 minutes. The supernatant was collected and adjusted to pH5.0 using 2M acetic acid solution. A second centrifugation was performed, at 40,000G for 10 minutes and the supernatant was adjusted to pH7.0 using 1M ammonium hydroxide. Solid ammonium hydroxide was added (0.54g per ml) to give an 82% saturated solution, which was stirred gently for 30 minutes before centrifugation at 40,000G for 15 minutes. The precipitate was resuspended in cold 25mM potassium phosphate buffer containing 0.1mM EDTA (pH7.5) (0.44ml buffer per mg original tissue). Overnight dialysis was performed against the resuspension buffer and the enzyme product was stored at -20°C until required. Histamine assays were performed to analyse the enzyme activity of the product.

The histamine detection assay is based on the transfer (methylation) of the 3H group from [^{3}H] S-adenosyl-methionine ([^{3}H] SAME) to histamine by the HNMT enzyme, to form tritiated N-π-methylhistamine, Verburg et al, 1983. The histamine detection assay was performed as outlined in Gitomer and Tipton, 1986, using 0.1μCi of [^{3}H] S-adenosyl-methionine, 2mM S-adenosyl-methionine in a total reaction volume of 100μl. The reaction was initiated by the addition of enzyme and incubated at 37°C for 30 minutes, and terminated by the addition of 7% sodium borate solution, pH10.6. The tritiated histamine was extracted using toluene:isoamyl alcohol (1:1 v/v) and 800μl of the aqueous phase was added to 2ml Ultima Gold. The radioactivity was detected by scintillography.

Column separation was effected as discussed in Verburg et al, 1983, using potassium phosphate buffers containing 0.1mM EDTA (pH7.5). DEAE Cellulose separation was performed using 100mM and 750mM buffers, followed by separation over phenyl Sepharose, with elution using 400mM and 10mM buffers. All chromatographic procedures were performed using gas purged buffers, to reduce oxidative inactivation of the enzyme, and the fractions were maintained on ice. The protein content of the eluted fractions was ascertained by spectrophotometry at 280nm wavelength and only those fractions with the highest value were retained for study.

Accurate protein concentrations were ascertained by use of the Coomassie Plus protein assay reagent system (SIGMA), and comparison with BSA standards.

N-acetyl-β-glucosaminidase assay

This assay was performed as described in Yasuda et al, 1995. An aliquot of cell supernatant was added to 10mM p-nitrophenyl-acetyl-β-D-glucosamine, maintained in 0.1M citrate buffer at pH4.0. The samples were incubated at 37°C for 30 minutes and the reaction terminated by the addition of 0.4M glycine buffer, pH10.6. Colour generated wad detected by spectrophotometry at 405nm wavelength on an ELISA reader.

IL-4 assay

IL-4 was detected using the DuoSet IL-4 Detection Kit (Genzyme Diagnostics). The detection method was performed according to manufacturer's instructions. All suggested volumes were halved to maximise economic use of the reagents provided.

Cell Experiments

RBL-2H3 Cell Culture

The RBL-2H3 cell line was cultured so that the detection assays could be optimised without the need to withdraw human blood. The cells were cultured according to Gilfillan et al, 1992. Briefly, the cells were maintained in Eagles Modified Essential Medium supplemented with 10% heat inactivated FCS, 100 units /ml penicillin, 100µg/ml streptomycin/gentacmycin and 2mM L-glutamine at 37°C in a humidified atmosphere of 95% air and 5% carbon dioxide. Cell splitting was achieved using cell scrapers.

Cell Lysis

Prior to performing experiments to determine the variation in mediator release following activation, it was necessary to determine the total concentration of each mediator per cell. This enabled mediator release to be expressed as a percentage of the cell's total capacity. These determinations were achieved by cell lysis. Three methods of lysis were optimised:

(1) Triton lysis: incubation with 1-10% Triton X-100 for 15 to 90 minutes.

(2) Heat lysis: incubation at 85°C for 2 to 15 minutes.

(3) Freeze lysis: incubation at -20°C for 30 minutes.

The efficiency of lysis was determined by microscopy and the mediators detected as described.

IgE-Cross Linking

The IgE cross-linking was performed as described by Gilfillan et al, 1992. RBL-2H3 cells were grown to confluency and then replated in a 6-well plate at a density of $1x10^6$ cells per well. The cells were cultured overnight in supplemented medium containing anti-DNP IgE, washed twice with medium, and once with HEPES buffer (137mM sodium chloride, 2.7mM potassium chloride, 0.4mM disodium phosphate, 5.6mM glucose, 10mM HEPES, 1.8mM calcium chloride, 1.3mM magnesium sulphate, pH7.4). Mediator release was triggered by the addition of DNP-HSA (10ng/ml) diluted in HEPES buffer and incubation effected

for 30 minutes. Mediator release was detected from the supernatant, as discussed in section 2.

Experiments were performed to ascertain the concentration of anti-DNP IgE antibody and DNP-HSA to achieve optimal mediator release.

Elucidation of IgE status of Human Basophils:
Basophil Extraction

A crude basophil extraction, based on dextran sedimentation, was performed as described in Pruzansky and Patterson, 1981. Briefly, blood was obtained by venipuncture and EDTA (pH7.5) was added to a final concentration of 25mM. Dextran-70 was added to a final concentration of 6% and the mixture was left to sediment. The upper, leukocyte containing, layer was removed and centrifuged at 200g for 12 minutes. The cell pellet was washed with HEPES buffered saline (140mM sodium chloride and 10mM HEPES, pH7.4) and resuspended in HEPES AGM (25mM HEPES, 110mM sodium chloride, 5 mM potassium chloride, 2mM calcium chloride, 1mM magnesium chloride and 0.3 mg/ml human serum albumin, pH7.4).

Alcian Blue Staining

Alcian blue staining was performed as discussed in Gilbert and Ornstein, 1975. In summary, 100µl of cell suspension was diluted with 400µl of 0.1% EDTA in saline, 450µl staining solution (0.076% cetyl pyridinium chloride, 0.7% lanthanum chloride.$6H_20$, 0.9% sodium chloride, 0.21% Tween 20, 0.143% alcian blue 8 GN in deionized water, filtered through a 1µ filter) and 50µl

of 1M hydrochloric acid. After gentle agitation, the cells were counted in a Fuchs-Rosenthal Haemocytometer.

Lactic Acid Stripping

Standardisation of experiments necessitated the use of the same basophils in each case. Therefore it was necessary to remove their native IgE and adsorb alternative IgE onto the surface. Surface bound IgE was dissociated from basophils with the use of the lactic acid elution method described by Sampson et al, 1989. The leukocytes were pelleted and resuspended in 5ml lactic acid solution (0.01M lactic acid, 110mM sodium chloride, 5mM potassium chloride, pH3.9). The suspension was incubated at 23°C for three and a half minutes, after which time the lactic acid was diluted with 30ml PIPES buffer (25mM PIPES, 110mM sodium chloride, 5mM potassium chloride, 0.03% human serum albumin, 0.1%D-glucose, pH7.4).

Passive Sensitisation

Passive sensitisation method was based on that described in Pruzanksy et al, 1981 and Levy and Osler, 1966. Cells were incubated at with 250ng IgE per million basophils 37°C for 60 minutes.

HRF assay

A 1 in 10 serial dilution of HRF was effected prior to incubation at 37°C for 45 minutes in a heating block. The mediator chosen for study was β-hexosaminidase.

Alkaline Inactivation of Foetal Calf Serum

Inactivation of GPI-PLD activity in Foetal Bovine Serum was achieved according to the method of Kung et al (Biochimica et Biophysica Acta, 1997, 1357, 329 - 338). Briefly, FCS was adjusted to pH 11 using concentrated hydrochloric acid, and incubated for 1 hour at 37°C. After this time, the pH was adjusted to 7.4, and GPI-PLD activity was determined using an enzymatic assay (Davitz et al, 1989).

In order to ascertain how this serum affected the function of RBL-2H3 cells, the FBS in the culture medium was replaced with the inactive serum, and the cells were cultured as normal.

IgE Cross Linking Assay

RBL-2H3 cells were grown to confluence, after which time the adherent cells were removed from the culture flask using a cell scraper. The cell density was determined, using a haemocytometer, and adjusted to 2 x 10^5 per ml. The cells were seeded at 1ml per well in a 24 well culture plate and cultured for overnight at 37°C in a humidifed 5% CO_2 incubator.

The overnight culture media was aspirated and replaced with fresh media containing Rat IgE anti-DNP at 3µg/ml. After a 2 hour incubation period, the media was aspirated, and the cells were washed twice, with HEPES Buffered Saline. Cross-linking was achieved by the addition of 200µls of DNP-Albumin at 100ngs/ml (diluted in HEPES AGM), and incubation for 2 hours. The release

of the total mediator content of the cells was accomplished by incubation with 200µls 5% Triton X-100 detergent. In addition, the cells were stimulated to release using the calcium ionophore, A23187.

Mediator release was determined using a colorimetric assay to detect the presence of β-hexosaminidase and compared with the total cell β-hexosaminidase content (Yasuda et al, Int. Immunol., 1995).

Results

IPGs obtained from basophil cell line RBL 2H3 cause the release of histamine from the RBL 2H3 cells

Figure 1 shows that IPGs obtained from a basophil cell line RBL 2H3 cause the release of histamine from the RBL 2H3 cells. The basophil derived IPG was obtained by cross-linking the IgE receptors on the surface of the RBL 2H3 cells which stimulates the interaction of an allergen with the basophil. Specifically, RBL 2H3 cells were sensitised with anti-DNP IgE (which binds to the IgE receptors present on the basophil surface) and then triggered with the antigen DNP-HSA. This antigen (DNP-HSA) triggering results in histamine release. The culture supernatants were extracted and Figure 1 shows that:

(a) IPG could be obtained from the supernatants and that allergen stimulation results in IPG release.

(b) The purified IPGs when added to non-allergen stimulated cells resulted in the release of histamine

indicating that the IPG was the second messenger for allergic stimulation.

Histamine release caused by IPGs is tissue specific

Figure 2 shows that the response is tissue-specific since IPGs isolated from human placental were not able to cause histamine release (the hexosaminidase release (y axis) is a surrogate marker for histamine release).

Rat liver A-type IPG is a specific antagonist of histamine release

Figure 3 shows that rat liver P-type IPG has no effect on the RBL 2H3 cells. In contrast, the rat A-type liver IPG was able to block some of the spontaneous release. The effect is specific since no inhibition was seen in the absence of calcium (Figure 3 bottom).

The role of GPI-PLD in type one hypersensitivity reactions

The role of Glycosylphosphatidyl-inositol Phospholipase D (GPI-PLD) in the Type One Hypersensitivity reaction was then examined. This reaction involves the cross-linking of IgE receptors on the mast cell surface, leading to the release of allergic mediators, and can be experimentally reproduced using rat basophilic leukaemia cell line, RBL-2H3. These cells naturally have unoccupied IgE receptors (FcεR1, or high-affinity receptors), allowing them to be passively sensitised with an IgE isotype of choice. The allergic reaction can be mimicked by cross-linking of the IgE.

Previous research indicates that RBL-2H3 cells derive their GPI-PLD from the culture serum (data not shown). Therefore, it follows that inactivation of this external source of GPI-PLD would deprive the cells of any further enzyme.

Results indicate that the alkaline treatment of FBS severely depleted the serum's GPI-PLD activity (data not shown).

When the inactive serum was used in the culture medium, the appearance of the cells was not dramatically altered, although their adherence seemed to be slightly reduced. However, the cells rapidly lost their ability to release mediators, following cross linking of the FceR1 receptor on the cell's surface, or following stimulation with A23187 (Figure 4b). The loss of activity was approximately half, when compared with the release from cells which were cultured normally (Figure 4a).

In order to ascertain whether these "inactive" cells had been irreparably damaged by their incubation in the alkaline treated FBS, the cells were transferred back into medium in which the FBS had not been altered. When the cells are split at a low density, allowed to gain confluence, and then used in the stimulation experiments, the cells partially regained their capacity to respond to both FcεR1 cross linking and A23187 stimulation (Figure 4c). This indicates that the cells have not been irreparably damaged by their altered culture conditions.

Alkaline treatment of FBS appears to affect the function of a serum component, which is essential in the release of mediators from RBL-2H3 cells, following stimulation using two methods.

Although assay of GPI-PLD indicated a loss of activity of the enzyme, and this enzyme has been suggested as having an important function in basophil function, it is highly probable that there are other components of the serum, which would be affected by alkaline conditions. It is widely known, for example, that the growth factor TGF-β would be activated by this treatment.

The results suggesting that the stimulation of basophils by ionophore is affected by this serum component may also involve GPI-PLD depletion in this process. We have found the following: GPI-PLD depletion results in the down expression of caveolin, an important component of caveolae; calcium uptake and ionophore action is known to occur in caveolae.

Deposits

The deposit of hybridomas 2F7, 2D1 and 5H6 in support of this application was made at the European Collection of Cell Cultures (ECACC) under the Budapest Treaty by Rademacher Group Limited (RGL) (formerly Hoeft Rademacher Limited), The Windeyer Building, 46 Cleveland Street, London W1P 6DB, UK. The deposits have been accorded accession numbers accession numbers 98051201, 98031212 and 98030901. RGL authorises the University College London to refer to the deposited biological materials in

this application and both RGL and University College London give their unreserved and irrevocable consent to the materials being made available to the public in accordance with appropriate national laws governing the deposit of these materials, such as Rules 28 and 28a EPC. The expert solution under Rule 28(4) EPC is also hereby requested.

References:

The references mentioned herein are incorporated by reference in their entirety.

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Claims:

1. Use of an IPG antagonist in the preparation of a medicament for the treatment of conditions mediated by the release of IPGs from mast cells, basophils or eosinophils.

2. The use of claim 1 wherein the condition mediated by release of IPGs is atopic dermatitis, food hypersensitivity, allergies including seasonal, contact, drug, pollen, insect allergies, asthma (early and late phase), allergic interstitial pneumonitis, eczema, environmental lung disease, or another disorders mediated by infiltration of mast cells, basophils or eosinophils, or cells within their respective lineages.

3. The use of claim 1 or claim 2 wherein the IPG antagonist is an anti-IPG antibody.

4. The use of claim 1 or claim 2 wherein the IPG antagonist is a substance capable of inhibiting or preventing IPG release in mast cells, basophils or eosinophils in response to an allergen.

5. The use of claim 4 wherein the antagonist is an inhibitor of the enzyme GPI-PLD.

6. The use of claim 5 wherein the antagonist is an antibody capable of inhibiting IPG release by inhibiting cleavage of the IPGs caused by the enzyme GPI-PLD.

7. The use of claim 1 or claim 2 wherein the IPG antagonist is a competitive antagonists of the IPGs

released from mast cells, basophils or eosinophils.

8. The use of claim 7 wherein when the medicament is used to treat a human patient, the competitive IPG antagonist is an IPG derived from a non-human species.

9. The use of claim 8 wherein the antagonist is A-type IPG as obtainable from rat liver.

10. An inositolphosphoglycan (IPG) as obtainable from mast cells, basophils or eosinophils which is capable of causing histamine release from mast cells, basophils or eosinophils.

11. An inositolphosphoglycan (IPG) as obtainable from mast cells, basophils or eosinophils which is capable of causing histamine release from mast cells, basophils or eosinophils for use in a method of screening for antagonists of said IPG.

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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A3

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(71) Applicant *(for all designated States except US)*: UNIVERSITY COLLEGE LONDON [GB/GB]; Gower Street, London WC1E 6BT (GB).

(72) Inventors; and

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(74) Agents: KIDDLE, Simon, J. et al.; Mewburn Ellis, York House, 23 Kingsway, London WC2B 6HP (GB).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

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(88) Date of publication of the international search report:
18 November 1999 (18.11.99)

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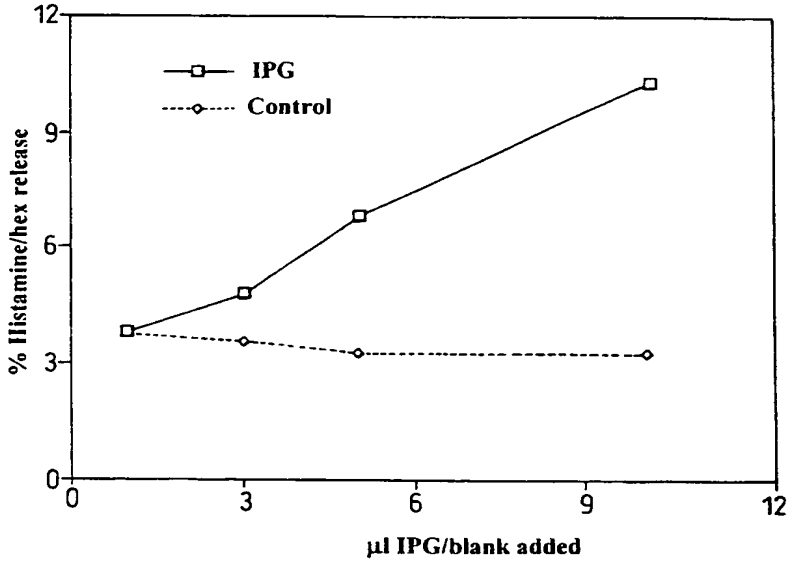

(57) Abstract

This application discloses that inositolphosphoglycans (IPGs) can be obtained from basophils, eosinophils and mast cells and that allergen stimulation of these cells results in IPG release. It also shows that IPGs are second messengers for allergic stimulation as the addition of some types of purified IPGs to non-allergen stimulated cells resulted in histamine release or degranulation. Thus, IPG antagonists can be used for the treatment of conditions (especially allergy and asthma) mediated by the release of IPGs from mast cells, basophils or eosinophils. Preferred IPG antagonists include anti-IPG antibodies, inhibitors of the enzyme GPI-PLD and competitive antagonists.

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/00981

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A61K31/70 A61K39/395

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	RADEMACHER T W ET AL: "Inositolphosphoglycan second messengers." BRAZILIAN JOURNAL OF MEDICAL AND BIOLOGICAL RESEARCH, (1994 FEB) 27 (2) 327-41. , XP002050248 cited in the application	1-9
Y	opening paragraph and the first paragraph on page 334	10,11

Y	WO 98 10791 A (HOEFT RADEMACHER LTD., UK;RADEMACHER, THOMAS WILLIAM; MCLEAN, PATRICIA) 1997 page 10, line 16 - page 16, line 1 page 17, line 19 - page 17, line 20	10,11

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search	Date of mailing of the international search report
16 September 1999	24. 09. 99

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/00981

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 98 11435 A (HOEFT RADEMACHER LIMITED, UK;RADEMACHER, THOMAS WILLIAM; MCLEAN, PATRI) 1997 page 13, line 15 - page 18, line 35 page 20, line 17 - page 20, line 18 ---	10,11
Y	WO 98 11117 A (HOEFT RADEMACHER LTD., UK;RADEMACHER, THOMAS WILLIAM; CARO, HUGO) 1997 cited in the application page 11, line 3 - page 15, line 7 page 34, line 28 - page 36, line 13 page 25, line 10 - page 25, line 31 ---	10,11
Y	WO 98 11116 A (HOEFT RADEMACHER LTD., UK;RADEMACHER, THOMAS WILLIAM; CARO, HUGO) 1997 cited in the application page 10, line 17 - page 14, line 21 page 17, line 14 - page 18, line 9 page 30, line 1 - page 31, line 23 ---	10,11
Y	WO 96 29425 A (UNIV LONDON ;RADEMACHER THOMAS WILLIAM (GB); CARO HUGO NORBERTO (G) 26 September 1996 (1996-09-26) example 2A -----	10,11

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 99/00981

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons.

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 1,2,4,7
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 1,2,4,7

A composition or compound cannot be characterised by its mechanism of action sufficiently to allow a complete search to be made. As a consequence, the use of the term "IPG antagonist" in Claim 1 makes a complete search of the present claims impossible

Furthermore, the term "IPG antagonist" is considered to be unclear and unduly broad in scope.

Consequently, the search has been carried out for those parts of the claims which appear to be supported and clearly disclosed, namely those parts relating to Claims 3, 5, 6, 8 and 9.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 99/00981

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9810791 A	19-03-1998	AU 4310297 A	02-04-1998
		EP 0939651 A	08-09-1999
WO 9811435 A	19-03-1998	AU 4130497 A	02-04-1998
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		EP 0815255 A	07-01-1998
		JP 11503307 T	26-03-1999

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International application No. PCT/GB99/00981	**Applicant's or agent's file reference** SJK/BP5765615
International filing date (day/month/year) 29 March 1999 (29.03.99)	**Priority date** (day/month/year) 27 March 1998 (27.03.98)
Applicant RADEMACHER, Thomas, William et al	

1. The designated Office is hereby notified of its election made:

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